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FAN MOTOR ASSEMBLY WITH NOISE SUPPRESSION

The present invention generally relates to electric motors or generators, and , more particularly, relates to a motor-fan unit employing heat stable, noise-absorbing foam, in proximity to moving parts or surrounding moving parts thereof, to absorb noise generated by the unit.

BACKGROUND ART

Electric motors and generators are well known in the art and have been put to use in a variety of applications. One application is the handling of air. In these circumstances an electric motor is coupled with a fan to generate an air flow or vacuum as necessary. Often, the fan is used to provide cooling air to the motor. In these instances, a fan mounted on a shaft driven by the motor draws air into a fan shroud to compress or pressurize the air. The pressurized air is released into the motor housing via one or more ports which direct the air across the motor windings to draw heat into the flow and exhaust it from the motor housing. Alternatively, the shroud may have exhaust ports so that the air-flow bypasses the motor windings.

Known motor assemblies have a propensity for generating noise. The fan includes vanes that typically have sharp edges. As air flow is generated over these edges and transitions to another guiding surface noise is generated. In addition to the noise being an undesirable feature, it introduces inefficiencies into the flow of air which decrease motor performance.

While it has been known to supply foam for purposes of muffling noise generated by various devices, including motors, the foam is always placed in spaced relation to heat generating elements in order to avoid thermally degrading the foam. This makes the positioning of the foam difficult and may require the construction of additional support structures within the devices. Use of foam for noise suppression properties in motors has also been problematic in that the foam, once ignited, continues to burn, rendering the motor and associated equipment inoperable. In order to ensure that the motor temperature does not reach the ignition temperature of the foam, it is required to attach a costly current and/or temperature sensor to the assembly. Once the sensor detects excessive heat or

current, the motor is shut down to prevent igniting of the foam. Thus, there is a need in the art for low noise generating motor-fan units that do not suffer from these deficits.

SUMMARY OF THE INVENTION

The disclosure herein provides a low noise air moving motor-fan unit comprising a motor assembly having a rotatable shaft; a fan assembly coupled to said rotatable shaft to rotate therewith and generate an airflow that passes over at least a portion of said motor assembly; and a noise suppression sleeve at least partially disposed around said motor assembly.

It is another aspect of the invention to provide a motor-fan unit comprising a motor assembly having a rotatable shaft; and a fan assembly coupled to the motor assembly, the fan assembly including a fan secured to the shaft, a fan end bracket for carrying the motor assembly, the fan end bracket having bracket openings therethrough, and a diffuser coupled to the fan end bracket, the diffuser having peripheral openings therethrough, wherein rotation of the fan generates an airflow that passes through the bracket openings and the peripheral openings, the fan assembly carrying at least one foam piece to absorb noise generated by the fan.

BRIEF DESCRIPTION OF THE DRAWINGS

For a complete understanding of the objects, techniques and structure of the invention, reference should be made to the following detailed description and accompanying drawings, wherein:

Fig. 1 is a partially sectioned front elevational view of a motor-fan unit according to the present invention showing details thereof;

Fig. 2 is a plan view of an end plate according to the present invention depicting details of a diffuser side of a fan end bracket;

Fig. 3 is a perspective view of a radial diffuser according to the present invention;

Fig. 4 is a perspective view of a ported diffuser according to this invention;

Fig. 5 is a top plan view of a peripheral bypass motor-fan unit in accordance with this invention; and

Fig. 6 is a top plan view of a tangential bypass motor-fan unit in accordance with this invention.

DETAILED DESCRIPTION OF THE INVENTION

Fig. 1 shows a motor-fan unit generally indicated by the numeral 10 and which generally includes a motor assembly 15 and a fan assembly 25. The motor assembly 15 includes an electric motor 16 with an armature or windings 17, a commutator 18, and brushes (not shown) which provide a connection from the power source to the commutator 18 and the windings 17. A shaft 20 is supported on suitable bearings such that it is freely rotatable and is connected to the commutator 18 so as to rotate therewith.

As shown in Fig. 1, the motor assembly is configured with the commutator 18 closest to the fan assembly 25. The fan assembly 25 of motor-fan unit 10 includes a fan 26 coupled to one end 27 of shaft 20, as by a nut, such that it rotates therewith. The fan assembly 25 further includes a shroud 30 that surrounds the fan 26. As is known in the art, the shroud 30 is provided with an axial aperture through which outside air is drawn by the fan 26. In the embodiment shown, shroud 30 includes a centrally located inlet port 31 formed in a cover portion 32 of shroud 30 coaxially located with the axis A of shaft 20. The air is exhausted by the fan 26 which is received by a diffuser 80 (to be described more particularly which distributes the air as needed by the end use. A more detailed disclosure of the components of a motor-fan unit 10 is found in U.S. Patent Number 6,703,754, incorporated herein by reference, and the present application focuses upon the advances to more specific elements of the motor-fan unit 10.

With reference to Figs. 1 and 2, motor assembly 15 is provided with a fan end bracket or bracket assembly, generally indicated by the numeral 35. The fan end bracket 35 generally includes a planar plate portion 36, which may be annular as shown, and, bracket openings 75 adjacent motor bracket portions 37 extending from the plate portion toward the motor 16. Motor bracket portions 37 are adapted to support the motor assembly 15, and is herein adapted to decrease the noise generated by the motor-fan unit 10 through the provision of foam F on the inner surfaces thereof, adjacent said bracket openings 75. The foam F decreases vibration noise by absorbing waves generated by the movement of the fan vanes through the air and by easing the generated air flow from one direction to another. In other words, as air flow is driven by the fan vanes it is routed by the plate portion 36 through the openings 75 and against the bracket portions 37. The foam F which

is adhered or otherwise fastened to the portions 37 absorbs airflow generated noise and prohibits further generation of noise by providing an absorptive air-flow transition surface.

The foam F is preferably a V-0 rated foam. Such foam is characterized by properties determined in accordance with UL 94 standards. The foam is heat resistant and has self-extinguishing flame properties, meaning, if the foam encounters sufficient heat for combustion, any flame initiated will not be able to continue burning through the combustion of the foam upon removal of the ignition source. An exemplary foam has a flash point at least greater then 400°C and an auto-ignition temperature at least greater than 580°C. A particularly preferred foam is melamine foam, and, in a particularly preferred embodiment, Polydamp™ Melamine Foam (PMF; Polymer Technologies, Inc.) is employed. PMF exhibits exceptional resistance to heat and low flammability levels. It does not drip when ignited, and stops burning upon removal of the ignition source. And PMF produces minimal flame and smoke. Indeed, it has been found that use of such a foam precludes the need for costly temperature or current sensors to maintain the motor at a limited temperature that would otherwise ignite the foam.

The motor-fan unit 10 herein further benefits from the provision of noise suppression sleeve 200, which is at least partially, and preferably completely, disposed around at least a portion of said motor assembly 15, as shown in Fig. 1. This sleeve 200 is made from V-O rated foam, preferably melamine foam. The sleeve 200 surrounds a majority of the motor 16 and absorbs and muffles noise generated by motor assembly 15 and fan assembly 25. Indeed, it is believed that the cellular construction assists in diffusing the noise frequencies generated by the fan assembly and further that the foam deflects the noise frequencies in a labyrinth manner so that by the time the air flow exits the motor assembly, the associated noise frequencies are significantly reduced. The sleeve 200 attaches to the fan assembly 25 at a shroud end 204 of the sleeve 200, and a sleeve cover 202 may cap the noise suppression sleeve 200 at distal end 206, opposite shroud end 204. Sleeve cover 202 may include a cover hole 208, and, in the embodiment shown, a portion of the motor assembly may extend through the cover hole 208. If desired, the sleeve may be sized longer than the extending length of the motor assembly as shown by the sleeve 200'. The sleeve may be attached by fasteners, clips, adhesives, a friction fit or any way in which the sleeve can be held in close proximity to the unit 10. Distal end 206 may curve inwardly to form a sleeve opening 210, foregoing the use of a specific cover element

like cover 202. It will be further appreciated that use of the cover 202 is optional. The V-0 rating ensures that the foam F will not be damaged by the heat generated by the operation of motor 16. Preferably, the sleeve 200 is sized with a diameter that is not greater than the outer diameter of the shroud 30, as shown, and, it is also preferred that the sleeve cover 202 or sleeve opening 210 be in close proximity or touching contact with the motor assembly 15. And it has been found that due to the use of a V-0 rated foam that placing the foam in touching contact or in very close proximity to the motor assembly, as evidenced by the sleeve 200', provides the best noise reduction properties while still maintaining the unit's operating efficiency.

This foam sleeve concept can also be applied to through flow motor-fan units and to tangential bypass motor-fan units. In Fig. 5, a bypass motor-fan unit 300 has the shroud 302 of its fan assembly 303 covered with noise suppression sleeve 304, made of V-0 Foam. Sleeve cover 306 is open at 308, and sleeve cover 306 preferably abuts shroud 302, as at 310. The shroud 302 includes a plurality of peripheral exhaust ports 311 for venting the air flow generated by the fan within the fan assembly 303. As noted previously, any conventional means may be used to secure the sleeve to the unit. The sidewall 312 of sleeve of 304 is preferably spaced a small distance from shroud 302 although it could be in touching contact.

In Fig.6, a tangential bypass motor-fan unit 400 has a tangential exhaust port 402 extending from the fan assembly 403 which is covered with noise suppression sleeve 404, made of the V-0 Foam. Sleeve 304 does not provide a sleeve cover, but rather is open at end 406. Sidewall 408 preferably abuts the outer surface of exhaust port 40, as generally shown. Extending from an interior surface of the sleeve may be internal flanges 408 that form a labyrinth flow path 410. The path 410 re-directs the air flow and the flanges effectively "scramble" or muffle the noise generated by the unit 400.

Additional benefits are realized by employing V-0 rated foam on other elements of a motor-fan unit 10, particularly diffuser assembly elements, which are disclosed below, with reference to Figs 3 and 4. A diffuser 80 interacts with fan end bracket 35 to distribute airflow generated by fan 26, and this combination is referred to as a diffuser/bracket assembly. The diffuser/bracket assembly (80/35) is coupled to the motor assembly 15 and rotatably receives the shaft 20. A radial-type diffuser assembly is shown in Fig. 3and designated generally by the numeral 80A, and a ported-type diffuser assembly is shown in

Fig. 4 and designated generally by the numeral 80B and both interact with a fan end bracket 35, wherein the fan 26 draws air in through fan shroud 30 and forces air out of the air diffuser/bracket assembly. Air from the fan assembly 25 is distributed by these diffuser assemblies 80A, 80B. For general reference, the diffuser assemblies, whether radial or ported-type, will be referred to by the numeral 80. Specific components of these diffusers will include an A or B suffix.

The radial diffuser 80A (Fig. 3) includes a planar base member 81, which may be made annular to define a bore 82. A plurality of circumferential blades 86A surround the fan 26 and serve to guide air outwardly from the fan side 85, wherein a portion may be directed externally of shroud 30 through a plurality of ports 34 provided in the shroud 30 (Fig. 1). A second set of blades 87A formed on the motor-side 84 of the radial diffuser 80A channels a remaining portion of the air radially inwardly toward the center of the diffuser 80A. The blades 87A may be configured in any pattern, as required by the particular application, including the spiral or pinwheel pattern shown. In contrast to the radial diffuser 80A, a ported diffuser 80B, as in Fig. 4, has circumferential blades 86B, at fan side 105, and enclosed channels 87B, extending from planar portion 104 and formed in similar patterns to the blades 86A, 87A of the radial-type diffuser 80A, to channel all the incoming and outgoing air as described above. The shroud for a ported diffuser 80B is completely enclosed.

Diffuser assemblies 80, whether of ported-type or radial-type, are provided with a pair of brush cap assemblies 95 that coact with brush retainers 120 which are generally shown in Fig. 2. In the embodiments shown in diffusers 80A, 80B, channels 93 are formed between a pair of upstanding brush cap members 96, 97 formed on the motor side (84 of diffuser 80A and side 105 of diffuser 80B). Members 96, 97 are generally located adjacent the central opening 82 and may radially project to an extent into the opening 82. The brush cap assemblies 95 of the ported-type diffuser are distinguished in that they are surrounded by channels 87B as opposed to blades 87A.

Herein, the diffuser assemblies 80 are taught to include V-0 foam F on certain elements. Particularly, V-0 foam F is provided on surfaces upon which the airflow impinges as the motor fan unit 10 is operated. More particularly Foam F is provided on blades 87A (radial diffuser) or enclosed channels 87B (ported diffuser). It is appreciated that these spiral/pinwheel patterned elements efficiently re-direct the airflow, and,

therefore, are generally major contributors to the noise generated by the motor-fan unit 10 which they are selectively employed. Notably, the surfaces of the blades 87A and enclosed channels 87B that curve in the direction of the rotation of the diffuser assembly 80 are the surfaces that are covered with Foam F.

It should now be understood that a new and useful motor-fan unit has been disclosed in accordance with the patent laws. It will further be understood that various modifications and substitutions may be made in the described invention without the departing from the spirit thereof, and, to appreciate the scope of the invention, reference should be made to the following claims.